

CLAIMS

What is claimed is:

- 1 1. A spark plug having at least one electrode connected in series with
2 a resistor, the resistors having low enough resistance such that pre-
3 ionization current flows without significantly changing a voltage applied
4 to the electrode and resistor, the resistance being high enough that the
5 voltage change on the electrode is substantial once a gap defined by the
6 electrode is ionized.
- 1 2. The spark plug of claim 1, having a plurality of the electrodes and
2 resistors arranged such that at least one pair of the electrodes form a gap
3 where the ionization current flows as a result of the voltage and once such
4 current flow occurs the ions formed in that gap then reduce the
5 breakdown field needed for ionization current to flow between a second
6 pair of the electrodes.
- 1 3. The spark plug of claim 1, having a plurality of the electrodes and
2 resistors arranged to form a series of gaps, the size of each gap adjusted to
3 facilitate ionization current flow to occur one after the other between the
4 series of gaps.
- 1 4. The electrodes of claim 1, having a plurality of the electrodes and
2 resistors coupled in parallel to the voltage, arranged to form multiple
3 parallel gaps which are ionized at approximately the same time.

- 1 5. A spark plug comprising:
2 a first and a second main electrode, spaced-apart by a distance N,
3 each electrode for receiving a different potential; and
4 a plurality of secondary electrodes, disposed between the main
5 electrodes, each having a gap between one another and the main
6 electrodes, each gap being different from one another, the sum of the gaps
7 being equal to the distance N.
- 1 6. The spark plug defined by claim 5, including a plurality of resistors,
2 one coupled to each of the secondary electrodes.
- 1 7. The spark plug defined by claim 6, wherein one of the main electrodes
2 is disposed through the center of the spark plug, and wherein the resistors
3 are connected between the center of the spark plug and each of the
4 secondary electrodes.
- 1 8. The spark plug defined by claim 6, wherein one of the main electrodes
2 comprises an outer threaded cylindrical housing, and wherein the
3 resistors are connected between each of the secondary electrodes and the
4 outer member.
- 1 9. The spark plug defined by claims 5, 6, 7 or 8, wherein each of the gaps
2 have an optimal gap distance, and wherein the actual gap distance is one-
3 third to two-thirds the optimal gap distance.

- 1 10. A spark plug comprising:
2 a main electrode;
3 a plurality of secondary electrodes, each having a gap from one
4 another, with a first of the secondary electrodes having a first gap with the
5 main electrode; and
6 a plurality of resistors each coupled between a common node and
7 one of the secondary electrodes.
- 1 11. The spark plug defined by claim 10, wherein the main electrode is part
2 of an outer cylindrical housing.
- 1 12. The spark plug defined by claim 11, wherein the secondary electrodes
2 are mounted on a generally coplanar surface.
- 1 13. The spark plug defined by claim 12, wherein the secondary electrodes
2 are linearly aligned.
- 1 14. The spark plug defined by claim 10, wherein all the gaps are between
2 one-third to two-thirds an optimum gap distance.
- 1 15. The spark plug defined by claim 10, wherein the main electrode is
2 coupled to a ground potential, and the common node is coupled to a high
3 potential.
- 1 16. The spark plug defined by claim 15, wherein each of the gaps is
2 different from one another.

1 17. The spark plug defined by claim 16, wherein the secondary electrodes
2 are arranged in a linear configuration.

1 18. A spark plug comprising:
2 a first and a second electrode defining a first gap;
3 a third and fourth electrode defining a second gap, the first and
4 second gaps near one another;
5 the first electrode and third electrode being coupled to a first node,
6 the third electrode being coupled to a first resistor to the first node;
7 the second electrode and fourth electrode being coupled to a
8 second node; and
9 the fourth electrode being coupled to a second resistor to the
10 second node.

1 19. The spark plug defined by claim 18, wherein the first gap is larger
2 than the second gap.

1 20. The spark plug defined by claim 18, including a fifth and sixth
2 electrode defining a third gap, the third gap being generally
3 spaced-apart and parallel to the second gap, and intersecting the
4 first gap.

1 21. The spark plug defined by claim 20, wherein the first, second and
2 third gaps are different from one another.

1 22. A spark plug comprising:
2 a first electrode;
3 a plurality of second electrodes, each having a gap with a first
4 electrode, each of the gaps having approximately the same distance from
5 the first electrode, and each having a clear path to the first electrode;
6 a plurality of resistors, each connecting one of the second electrodes
7 to a common node.

1 23. The spark plug of claim 22, wherein the first electrode is coupled to
2 an outer member of the spark plug, and wherein the common node is
3 coupled to a high voltage.
4

1 24. The spark plug defined by claim 20, wherein the resistors are sized
2 to induce to a voltage gradient from the first electrode to the second gap
3 then to the third gap then to the second electrode, during the time when
4 the second and third gap have sparked but the first gap has not.